Center Innovation Fund: LaRC CIF

Self-Healing Structural Materials for Damage Tolerant Aerospace Vehicles: Mechanoresponsive healing polymers

Completed Technology Project (2014 - 2015)

Project Introduction

Materials that are capable of puncture healing upon impact show great promise for space exploration applications wherein an internal breach caused by micrometeoroid impacts that would normally be considered catastrophic would now be self-contained. This type of material also provides a cross-cutting route for improved damage tolerance in load bearing structures and a means of self-mitigation or self-reliability in respect to overall vehicle health and aircraft durability. In puncture healing materials, healing is triggered by the ballistic or damage event. (Ballistics tests are used to simulate micro-meteoroid damage). The force of the bullet on material and the material’s response to the bullet (viscoelastic properties) activates healing in these materials. In this regard, our current efforts are focused on developing novel lightweight, self-healing systems where self-repair is induced by the forces imparted by the damage event itself. This is possible because damage is induced by an energetic source – high velocity projectile impact.

Designing and synthesizing a structural polymer matrix, that has the inherent ability to self-heal within fractions of seconds after impact damage is incurred, greatly improves vehicle safety by increasing the design allowable for strength, resulting in a more efficient structure. The new structural polymer envisioned will be designed such that recovery can occur autonomously or be activated after an application of a specific stimulus (e.g. heat, radiation). Effective self-healing requires that these materials heal quickly following low- to mid-velocity impacts, while retaining structural integrity.

Anticipated Benefits

1. Secondary or primary structures in aircraft or spacecraft. 2. Novel approaches in MMOD protection.

Novel approaches to development of cost efficient repairable wind power blades (Green initiative).

Novel approaches to fuel tank protection. Novel approaches to ballistic and/or hypervelocity protection.

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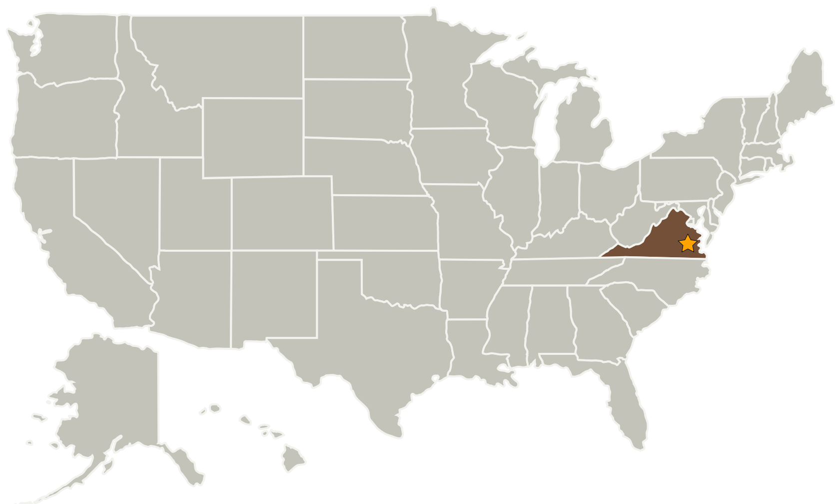
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Langley Research Center(LaRC)	Lead Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations
Virginia

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Langley Research Center (LaRC)

Responsible Program:

Center Innovation Fund: LaRC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Julie A Williams-byrd

Principal Investigator:

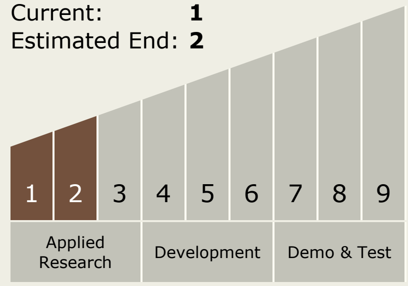
Keith L Gordon

Co-Investigator:

Emilie J Siochi

Technology Maturity (TRL)

Start: **1**
Current: **1**
Estimated End: **2**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  └ TX12.1 Materials
    └ TX12.1.1 Lightweight Structural Materials